

**BROOD YEAR REPORT  
DWORKSHAK NATIONAL FISH HATCHERY  
SPRING CHINOOK SALMON  
BROOD YEAR 2001  
LIFE CYCLE COMPLETED IN 2006**

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## **BROOD YEAR 2001 OVERVIEW**

<b>Life Stage</b>	<b>Number</b>
<b>2001 Rack Return</b>	<b>4,018</b>
<b>Number of Females Spawned</b>	<b>409</b>
<b>Total Eggs Enumerated<sup>1</sup></b>	<b>1,195,486</b>
<b>Average Eggs per Female</b>	<b>4,180</b>
<b>Eyed Eggs</b>	<b>1,163,838</b>
<b>Smolts Released</b>	<b>1,033,982</b>
<b>In-River Smolt Survival<sup>2</sup></b>	<b>70.4%</b>
<b>Adult Returns to the Hatchery<sup>3</sup></b>	<b>984</b>
<b>Adults Harvested in Idaho<sup>4</sup></b>	<b>698</b>
<b>Known Adult Return to Clearwater River</b>	<b>1,682</b>
<b>Adults Collected at Other Locations<sup>5</sup></b>	<b>909</b>

<sup>1</sup> Number based on the number of eggs culled and enumerated eyed eggs.

<sup>2</sup> Minimum survivals to Lower Granite Dam based on PIT tag interrogations.

<sup>3</sup> 1-Ocean, 2-Ocean, and 3-Ocean returns in 2004, 2005 and 2006 to the hatchery rack.

<sup>4</sup> Tribal and Sport fisheries combined.

<sup>5</sup> Fish recovered at various other hatchery racks, dams, fish traps, etc. down river of Lower Granite Dam.

## **DISCLAIMER**

Data in this report is as complete and accurate as possible at the time of printing. However, because of the life history complexity of spring Chinook salmon and the mixed stock fisheries in the Clearwater River, data is provisional and subject to future revision and corrections, especially in regards to the adult returns to the rack and harvest. All questions about the validity or precision of information in this report should be directed to the Idaho Fishery Resource Office, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, (208) 476-7242.

## **Citation for this report**

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## **Acknowledgments**

The Complex would like to acknowledge and extend much appreciation to all the other Administrative, Production, Maintenance, and Fish Health staff members at Dworshak Fisheries Complex who accomplish all the fundamental work of producing spring Chinook salmon at Dworshak National Fish Hatchery on an annual basis. From the time that adults are collected and spawned until the smolts are released almost two years later, the Production staff logs an incredible number of hours feeding, cleaning, and monitoring over a million fish on a daily basis. During that time, the Maintenance staff keeps a very complicated infrastructure of rearing containers, pumps, piping, electrical systems, and other equipment operational. The Fish Health staff provides continual testing and monitoring of infectious diseases and parasites. The Administrative Staff works behind the scenes to insure efficient and timely processing of all the necessary paper work required to keep everything operational. Your names might not be on the cover, but you are the people that are really responsible for all that the Complex accomplishes.

## INTRODUCTION

This report provides data for Brood Year (BY) 2001 spring Chinook salmon (SCS) at Dworshak National Fish Hatchery (NFH) which completed its life cycle in 2006. Data are summarized on the adults that were spawned to create the brood year, egg production, nursery rearing, juvenile rearing, smolt releases, fish health, smolt emigration to the ocean, adult contribution to fisheries, adult returns to the hatchery, and estimated total adult return to Lower Granite Dam. Evaluation projects and other research studies involving this brood year are only briefly described in this report and the reader is referred to the specific project reports for details. This Brood Year Report is one of several products called for in the Region One, U.S. Fish and Wildlife Service, Fisheries Vision Action Plan and is intended to provide a broad overview of stock performance and is a compilation of data from various other reports generated by the Dworshak Fisheries Complex.

The reporting of production data for Brood Year 2001 spring Chinook salmon for Dworshak NFH is complicated because of the adult holding, spawning, incubation, and nursery rearing of the spring Chinook salmon from Kooskia NFH. Although the two programs were kept separate as much as possible, these data were not always reported separately for the two stocks and summaries provided in various production and activity reports for Brood Year 2001 were occasionally combined. In those sections where data for the two stocks are combined, it will be pointed out. Otherwise, data is for Dworshak NFH stock.

### Program Goal

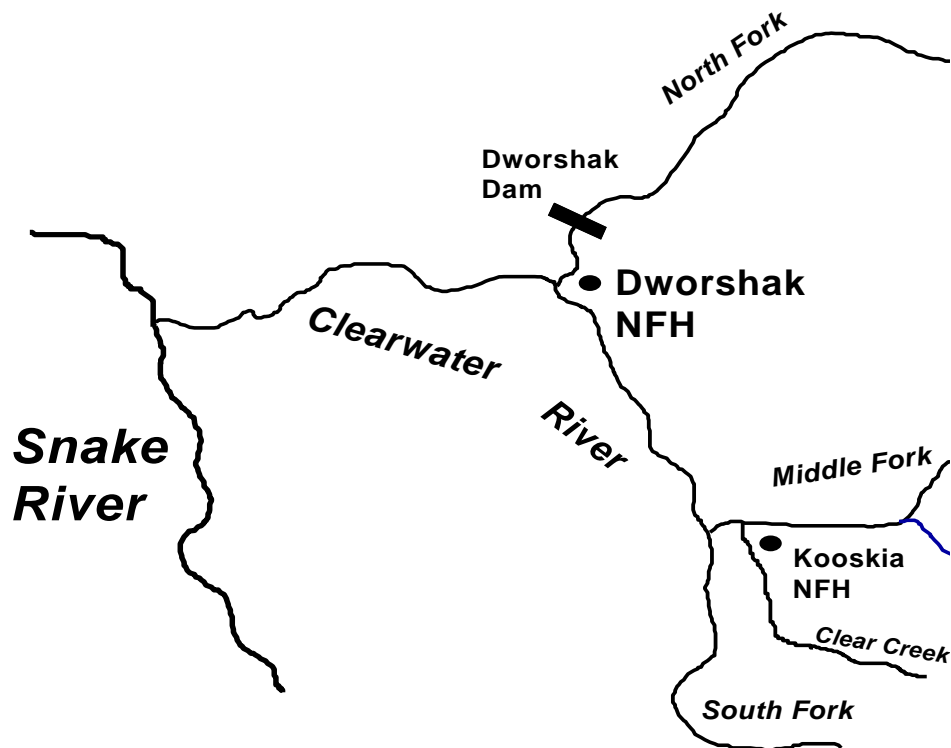
The spring Chinook salmon production program at Dworshak NFH was started in 1982 as part of the Lower Snake River Compensation Plan (LSRCP) and was originally designed to rear 1.4 million smolts to a size of 20 fish per pound (FPP) for direct release from the hatchery into the Clearwater River (U.S. Army Corps of Engineers 1981). This level of production was designed to meet the mitigation goal of 9,135 adults returning to Lower Granite Dam from the ocean (Herrig 1990). Over the years, several changes have been made to the facility and the production program. For Brood Year 2001, the smolt release target was 1,050,000 smolts reared to a size of between 18 to 20 FPP. The reduction in the number of smolts to be released was based on a change in rearing density as a result of an evaluation by Jones and Miller (1996) and the criteria developed by Integrated Hatchery Operation Team (IHOT).

### Site Description

Dworshak NFH is located at the confluence of the North Fork and the main stem of the Clearwater River near Ahsahka, Idaho (**Figure 1**). Adults enter the hatchery by a ladder located in the North Fork Clearwater River. Adults pass an electronic counter and enter an adult trap where they are held until they can be inventoried. Fish are mechanically crowded out of the holding pond, into a transfer channel, and into the spawning room where they can be measured and sorted. From the spawning room, adults are transferred to one of three long term adult holding ponds until they become mature and are spawned, are out-planted, or provided to the Nez Perce Tribe for ceremonial/subsistence use. The adult holding ponds are about 8,400 cubic feet in volume and can accommodate about 600-800 adult fish each. Fertilized eggs are incubated in Heath incubation trays. Dworshak NFH has 870 trays. Protocol calls for one female's eggs per tray giving the hatchery the capacity to incubate nearly 3.0 million spring Chinook salmon eggs. In previous years, fry were transferred to inside nursery tanks after

hatching. Dworshak NFH has 64 concrete tanks and 64 fiberglass tanks that hold about 667 and 643 gallons of water, respectively. The source of water for both the incubation and nursery rooms is Dworshak Reservoir. However, starting with BY1998, the production staff decided to transfer the fry directly into the outside rearing raceways, eliminating nursery rearing, in order to lessen the impact on the summer steelhead rearing program. Final rearing occurs in outside raceways. Dworshak NFH has thirty 8' X 80' concrete raceways in two separate “banks” (A and B) for juvenile Chinook rearing. Each bank has 15 raceways. All the raceways are supplied with single pass ambient river water from the North Fork Clearwater River.

**Figure 1.** Location of Dworshak National Fish Hatchery (NFH) at the confluence of the North Fork and main stem Clearwater River, Idaho.



## 2001 ADULT SPRING CHINOOK SALMON RETURN TO DWORSHAK NFH

### Pre-Season Assessment

The Idaho Fishery Resource Office (FRO) used a regression equation based on the 1-Ocean (Jack) returns in the previous year to forecast the return of 2-Ocean adults to Dworshak NFH the following year. In 2000, the original 1-Ocean return estimate was 496 (Table 9 in Idaho Fishery Resource Office 2000) fish, providing a prediction of 5,868 2-Ocean adults returning in the 2001 season (Idaho Fishery Resource Office 2000). However, based on revised data provided in 2011, the 1-Ocean age class was changed to 537. Thus, the original prediction for the 2001 return made in the 2000 annual report of 6,351 was lower than it should have been, and provides a partial explanation why the original prediction was lower than the actual return. Using the updated estimate for the 1-Ocean return in 2000, the prediction for the adult return in 2001 is much closer to the actual return, even though the predicted return was slightly higher than the actual return. The breakdown by age class for the predicted return made in 2000, the updated prediction made in 2011, and the actual estimated returns are given below in **Table 1**.

**Table 1.** Pre-season prediction, updated prediction made in 2011, and the estimated actual return in 2001 of adults to the Clearwater River, by ocean age.

Ocean Age	2000 Prediction for 2001 <sup>1</sup>	Updated Prediction with 2011 Data <sup>2</sup>	Actual 2001 Return <sup>3</sup>
I - Ocean	461	359	82
II - Ocean	5,868	7,484	7,337
III - Ocean	22	1,742	1,694
<b>Total</b>	<b>6,351</b>	<b>9,785</b>	<b>9,113</b>

<sup>1</sup> From Table 11 in Idaho Fishery Resource Office (2000).

<sup>2</sup> From Appendix Table 11 in Idaho Fishery Resource Office (2012).

<sup>3</sup> From Table 9 in Idaho Fishery Resource Office (2001)

### Total Rack Return

The total rack return is the number of adults that return to the hatchery and is not an accounting of the total return to the river. The 2001 adult spring Chinook salmon return to Dworshak NFH was 4,018 adults (**Table 2**).

**Table 2.** Actual rack return of adult spring Chinook salmon to Dworshak NFH by ocean age.

Ocean Age	Smolts Released <sup>1</sup>	2001 Rack Return <sup>2</sup>
1 - Ocean	1,017,873 (2000)	36
2 - Ocean	1,044,511 (1999)	3,235
3- Ocean	973,400 (1998)	747
<b>Total</b>		<b>4,018</b>

<sup>1</sup> From Table 6 in Idaho Fishery Resource Office (2001).

<sup>2</sup> From Table 4 in Idaho Fishery Resource Office (2001).

### Ladder Operations and Adult Inventories

Ladder operations at Dworshak NFH vary annually based on run strength and fishery management objectives. Once the ladder is opened, a fish counter monitors the number of adults entering the trap. The trap can optimally handle a maximum of about 900 adults. Prior to the start of spawning, the trap is emptied on a regular basis and the adults are inventoried and transferred to one of three adult holding ponds. During 2001, the hatchery ladder was operated intermittently from June 12 through September 14 for the collection of broodstock for Dworshak NFH. **Table 3** lists the dates that the ladder was operated.

**Table 3.** Ladder operations at Dworshak NFH during the spring and summer of 2001 to collect spring Chinook salmon adults for broodstock (Table 1, Dworshak National Fish Hatchery 2001).

Date Opened	Date Closed	Number of fish trapped
June 12	June 12	175
July 2	July 5	450
July 9	July 9	134
July 12	July 17	405
July 20	Aug 6	1,131
Aug 7	Aug 13	775
Aug 16	Sept 14	948
Total		4,018

Adult inventories were started on July 10 and were conducted intermittently through September 17, 2001. **Table 4** lists the number of adults in each ocean age class inventoried on each date.

**Table 4.** Number of spring Chinook salmon, by ocean age class, on each inventory date from 7/10/01 to 9/17/01, including trap mortalities and fish sampled for coded-wire tags (2001 Salmon News, Idaho FRO Files).

Inventory Date	1-Ocean	2-Ocean	3-Ocean	Total
July 10	11	527	221	759
July 18	3	314	88	405
July 26	5	308	79	392
August 7	5	597	136	738
August 16	5	661 <sup>1</sup>	110	775
August 24	3	385	53	441
August 27	1	11	0	12
September 11	1	301	46	348
September 13	0	39	1	40
September 17	2	54	9	65
Trap Mortalities And CWTs	0	38	4	42
<b>Total</b>	<b>36</b>	<b>3,235</b>	<b>747</b>	<b>4,018</b>

<sup>1</sup> Includes one new fish that was in the channel on 8/15 and was outplanted.

### Age Composition of Return

Age composition of spring Chinook salmon returning to the hatchery is based on fork length categories. These length categories were derived from known age/length/sex data from coded-wire tag (CWT) recovery databases. Ocean age categories are listed below:

- 1- Ocean (Jacks) < 56 cm
- 2 - Ocean = 57 to 81 cm
- 3 - Ocean > 81 cm.

Adult spring Chinook salmon that return to Dworshak NFH are predominately 2-Ocean fish, those that spend two years in salt water before returning to freshwater to spawn. The age composition for the 2001 return was 1% 1-Ocean, 80% 2-Ocean, and 19% 3-Ocean, respectively. The five year mean percent returns in the rack for 1-Ocean, 2-Ocean, and 3-Ocean adults were 24%, 53%, and 23%, respectively, for all years from 1996 to 2000 (**Table 5**).

When comparing the percentages of the 2001 return to the 5-year mean, the 2-Ocean return was much higher than the mean, while the 1-Ocean return was significantly lower. Overall the age composition of the 2001 adult return was very dissimilar to the 5-year mean with only 3-Ocean adults appearing normal (**Table 5**).

**Table 5.** Number and percent of adult spring Chinook salmon that returned to Dworshak NFH from 1996 to 2001, by ocean age (Appendix Table 3, Idaho Fishery Resource Office 2012).



<b>Return Year</b>	<b>I-Ocean</b>		<b>II-Ocean</b>		<b>III-Ocean</b>		<b>Total Return</b>
1996	275	28%	663	69%	25	3%	963
1997	12	0.4%	2,380	76%	740	23.6%	3,150
1998	11	1%	176	19%	728	80%	915
1999	670	84%	78	10%	52	6%	800
2000	221	7%	2,827	90%	104	3%	3,202
<b>Mean</b>	<b>237</b>	<b>24%</b>	<b>1,224</b>	<b>53%</b>	<b>329</b>	<b>23%</b>	<b>1,806</b>
2001	36	1%	3,235	80%	747	19%	4,018

### **Adult Marking**

Because of space and water temperature limitations at Kooskia NFH, all the spring Chinook salmon collected for brood stock at that hatchery were transferred to Dworshak NFH for holding and spawning. To ensure separation of stocks, all the Dworshak NFH adult spring Chinook salmon were marked with a left operculum V-notch and the adults from Kooskia NFH were marked with a right operculum V-notch.

### **Adult Holding and Mortality**

Formalin treatments were administered to adults in the holding ponds to retard fungus infection. Records documenting the exact dates and times could not be located, but treatment probably followed standard protocols. Generally, treatments start after the first inventory, being given three times per week until spawning starts. See the **Fish Health Section** for additional details.

Adult females were injected with Erythromycin to protect eggs from vertical transmission of *R. salmoninarum*. Each female received a dosage of 20 mg/kg of body weight. See **Fish Health Section** for details.

Despite efforts to the contrary, adult mortalities occur. Adult mortality is reported for two separate periods: pre-spawning (holding mortality) and mortality during spawning.

*Pre-Spawning Mortality* - From June 12 to August 20, a total of 167 adult spring Chinook salmon (4.2% of rack return) died.

*Mortality During Spawning* - From August 21 through September 11, an additional 105 adults died (2.6 % of rack return).

The total mortality was 272. Compared to previous brood years, the mortality rate for BY2001 spring Chinook salmon adults during holding was a much lower than average (**Table 6**).

**Table 6.** Percent mortality of adult spring Chinook salmon during holding (pre-spawning) and during spawning at Dworshak NFH, 1996-2001 ( **Table 9** in Dworshak National Fish Hatchery 2001).

Year	Pre-Spawning %	During Spawning %	Total %
1996	2.5	14.1	16.6
1997	3.6	4.6	8.2
1998	3.0	5.6	8.5
1999	3.1	17.7	20.8
2000	5.3	3.0	8.3
<b>5 yr Ave</b>	<b>3.5</b>	<b>9.0</b>	<b>12.5</b>
2001	4.2	2.6	6.8

Source: DNFH - SCS Spawning Reports BY1996-00.

DNFH - BY01SCS Enumeration and % Survival of Eggs Summary.

## Spawning

Details on the methods and procedures during spawning are provided in the Spawning Report for BY2001 (Dworshak National Fish Hatchery 2001). Spawning was started on August 21, 2001. A total of five egg takes were conducted with the last ripe females being spawned on September 11, 2001. A summary of spawning each week is presented in **Table 7**.

**Table 7.** Summary of spring Chinook salmon spawning during each egg take for BY2001 at Dworshak NFH (Dworshak National Fish Hatchery 2001, **Table 2**). Jacks are incorporated into the number of males spawned.

Take	Spawn Date 2001	No of Male	No of Female	Female culled BKD	Female culled grn eggs	Trays culled extra	Dead Eggs Enum	Eyed Eggs Enum	Total Eggs Enum	Eggs/Fmle	Percent <sup>1</sup> Enum Eye-up
1	08/21	14	22	5	0	0	3,808	73,094	76,902	4,524	95.0
2	08/22	39	74	4	0	0	5,537	298,524	304,061	4,344	98.2
3	08/29	115	166	45	5	25	9,735	350,000	359,735	3,953	97.3
4	09/05	78	107	2	1	0	11,649	427,900	439,549	4,226	97.4
5	09/11	42	40	36	0	0	919	14,320	15,239	3,810	94.0
Tot/Ave		288	409	92	6	25	31,648	1,163,838	1,195,486	4,180	97.4

<sup>1</sup> Percent enumerated eye-up does not include eggs/females culled before enumeration

Source: BY01 SCS Egg Enumeration and % Survival of Eggs Summary SC2001EggEnum.wk4  
IFHC BKD ELISA testing results BY01 SCS

## Adult Out-Planting

In years where the return of adults exceeds the brood stock needs of the program, excess adults that enter the ladder have been transported to various streams within the Clearwater River and released to spawn naturally. In 2001, the adult return was sufficiently large enough to supply excess adults for this purpose and 3,088 adults were out-planted. Arrangements were made with the Nez Perce Tribal Fisheries Department to transport excess adults to various tributaries throughout the Clearwater River basin for supplementation purposes. **Table 8** provides details on the dates, locations, and numbers of fish out-planted from Dworshak NFH.

**Table 8.** Numbers of adult spring Chinook salmon transported from Dworshak NFH to various tributaries in the Clearwater River, to supplement natural production (Idaho Fishery Resource Office 2001, Table 12).

Date	Location	Adults	Jacks	Total	Comments
July 24	Selway-McGruder	400	0	400	147 males; 253 females
August 2	Selway-McGruder	393	7	400	164 males; 229 females; 7 jacks
August 14	Lolo Cr.	402	1	403	171 males; 231 females; 1 jack
August 15	Newsome Cr.	297	6	303	126 males; 170 females; 1 unkn.
August 23	Lower Selway R.	468	1	469	148 males; 320 females; 1 jack
August 27	Lower Selway R.	510	4	514	203 males; 307 females; 4 jacks
Sept. 13	Lower Selway R.	337	2	339	119 males; 218 females; 2 jacks
Sept. 18	Lower Selway R.	281 <sup>1</sup>	4	285 <sup>1</sup>	177 males; 104 females; 4 jacks
<b>Totals</b>		<b>3,088</b>	<b>25<sup>2</sup></b>	<b>3,113</b>	

<sup>1</sup> 77 of these fish were excess brood stock from Kooskia NFH.

<sup>2</sup> Jacks were from Kooskia NFH.

## Adult Disposition

Of the total 4,018 adult spring Chinook salmon that entered the hatchery, the following is an accounting of adult disposition.

Number Spawned	697
Number Out-planted	3,011 (3,113-102 from Kooskia NFH, <b>Table 8</b> ).
Mortality During Holding	272
<u>Surplus Fish to the Landfill</u>	<u>38</u>
<b>Total</b>	<b>4,018</b>

## EGG PRODUCTION AND INCUBATION

Data on early incubation, eye-up, final incubation and hatching is found in Dworshak NFH annual reports for 2001 (Dworshak National Fish Hatchery 2002a) and 2002 (Dworshak National Fish Hatchery 2002b), the hatchery monthly production narratives, as well as the spawning report for BY2001 (Dworshak National Fish Hatchery 2001).

## Green Eggs Taken

Eggs are not enumerated until after eye-up. The number of green eggs taken initially is estimated using an average of 3,500 eggs per female. A total of 409 females were spawned, giving an initial estimate of 1,431,500 green eggs.

## Early Incubation (Dworshak NFH)

All eggs were incubated in Heath trays. Eggs from each female were incubated separately to segregate and track offspring by the Bacterial Kidney Disease (BKD) status (low/medium/high) of the female parent based on Enzyme-Linked Immunosorbant Assay (ELISA) tests (see **FISH HEALTH** section for detail). Water flow through the incubators was maintained at about 5 gal./m. Water temperatures averaged 40°F (Dworshak National Fish Hatchery 2001).

## Eggs Culled for BKD

For brood year 2001, a total of 92 females were culled from production for BKD.

## Eye-Up

At eye-up, eggs were shocked, dead eggs were removed, and eggs were enumerated by a mechanized egg picker. A total of 31,648 dead eggs were counted. The total number of eyed eggs enumerated was 1,163,838, giving an average of 4,180 eggs per female and an average percent eye-up of enumerated eggs of 97.4% (**Table 7**).

## Egg Transfers and Final Incubation

All of the Dworshak NFH eggs were transferred to Kooskia NFH in October and November, 2001 after eye-up and enumeration. **Table 9** lists the date and the numbers of eggs transferred (Dworshak National Fish Hatchery 2001).

**Table 9.** Dworshak NFH BY2001 spring Chinook salmon eyed egg numbers shipped to Kooskia NFH in 2001 (Dworshak National Fish Hatchery 2001, Table 4).

Date Shipped 2001	Take # Dworshak Stock	Dworshak Eyed Eggs to Kooskia
Oct 31	1 Dworshak	73,094
Oct 31	2 Dworshak	298,524
Nov 5	4 Dworshak	427,900
Nov 6	5 Dworshak	14,320
Nov 7	3 Dworshak	350,000
Total		1,163,838

## JUVENILE REARING

The following data and information was summarized from the 2001 and 2002 Annual Reports for Dworshak NFH, the Dworshak NFH monthly production narratives, and the Dworshak NFH monthly inventory summaries (MIS).

### Transfers and Handling

About 370,000 Dworshak NFH stock fry at Kooskia NFH were transferred back to Dworshak NFH April 22, 2002. On May 2 and 6, 2002, 767,992 additional fry were transferred from Kooskia NFH to Dworshak NFH. At the end of May there were 1,114,089 fry on station.

### Growth and Mortality

**Table 10**, (compiled from the Dworshak NFH monthly production narratives), provides a record of the estimated growth from May 2002 through March, 2003.

**Table 10.** Summary of monthly growth and mortality of Brood Year 2001 spring Chinook salmon during outside raceway rearing at Dworshak NFH.

Date (End of Month)	Number	Weight (lbs)	FPP	Mean Length (mm.)	Mean Growth (mm.)	Mortality (%)	Mean Water Temp (°F)
5/02	1,114,089	2,111	528	47	7	1.3	44.4
6/02	1,105,590	3,898	284	58	11	0.8	48.1
7/02	1,099,781	5,979	184	67	9	0.5	47.6
8/02	1,039,853	8,563	121	77	10	0.5	48.1
9/02	1,038,713	13,431	77	89	12	0.1	47.2
10/02	1,037,801	20,555	50	103	14	0.1	49.6
11/02	1,037,180	26,679	39	112	9	0.06	49.2
12/02	1,036,816	31,955	32	119	7	0.04	45.2
1/03	1,036,351	38,514	27	127	8	0.05	42.9
2/03	1,035,703	43,090	24	131	5	0.06	41.9
3/03	1,033,982	48,249	21	137	6	0.16	41.6

### Marking and Tagging

Coded-Wire Tags and Adipose Fin Clips- Adipose fin clipping and coded wire tagging of Dworshak spring Chinook fingerlings was conducted by the U.S. Fish and Wildlife Service, Lower Columbia River Fishery Office on August 21-22, 2002. A total of 137,222 Dworshak spring Chinook salmon fingerlings were coded-wired tagged to evaluate the contribution of Dworshak NFH to commercial, sport and tribal fisheries in the lower Snake and Columbia rivers as well as in the ocean. All the spring Chinook salmon smolts on station were adipose fin clipped to identify them as hatchery fish, providing the first complete and accurate inventory of spring Chinook salmon since spawning. Coded-wire tag retention rates, which ranged from 0.90 to 0.96, were determined by sampling about 500 fish from each tag code group in March 2003, prior to release. Details on coded-wire tagging are provided in **Table 10**.

**Table 10.** Coded-wire tag release information for Brood Year 2001 spring Chinook salmon released from Dworshak NFH in 2003.

Hatchery	Tag Code	Number of Tags	Number of Unmarked Fish	Mark Rate	Purpose
DNFH	050974	64,907 <sup>1</sup>	445,183	0.15	Contribution, A-Bank Representation <sup>2</sup>
	050975	61,944	452,514	0.14	Contribution, B-Bank Representation <sup>3</sup>

<sup>1</sup> The number reported is adjusted for mortality and tag loss.

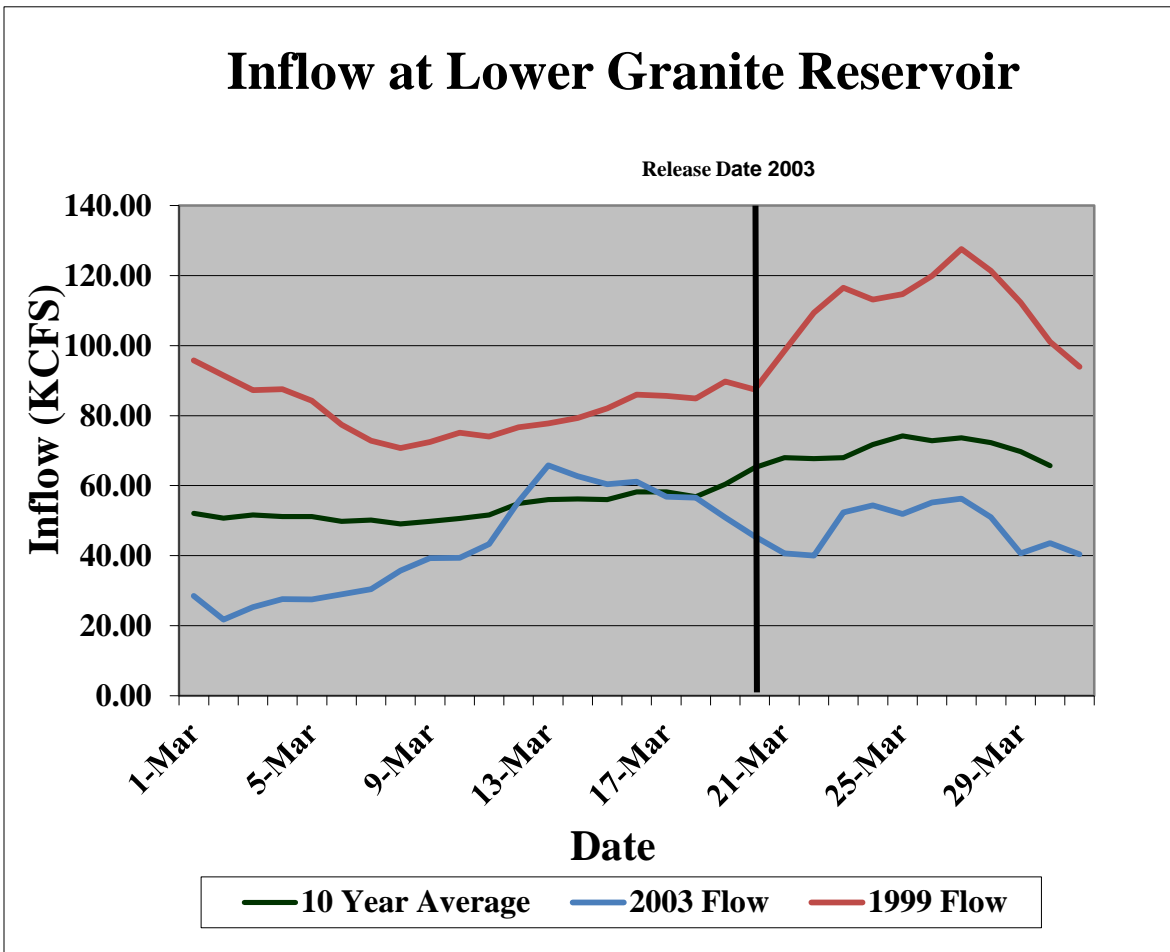
<sup>2</sup> Raceways A13 and A14.

<sup>3</sup> Raceways B28 and B29.

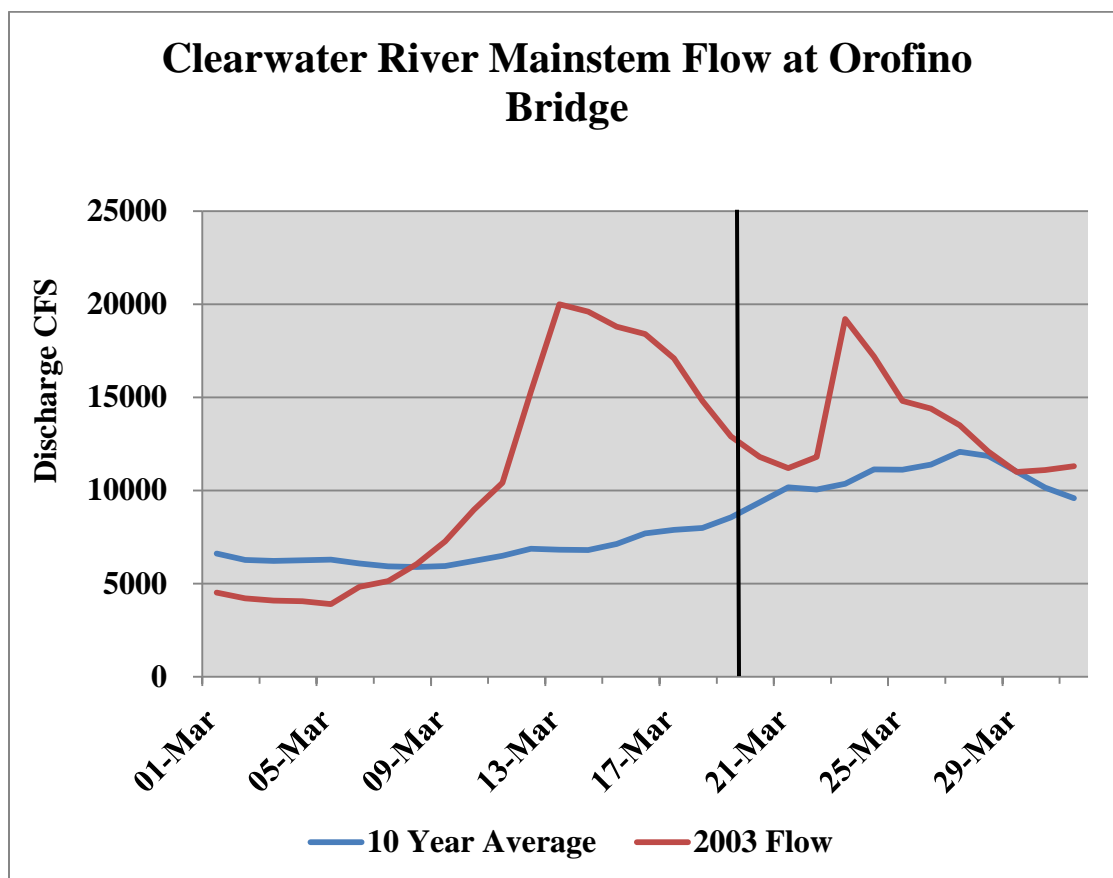
PIT tags - PIT tagging of BY01 spring Chinook smolts was conducted by the Idaho Fishery Resource Office between March 4 and 14, 2003. A total of 54,705 spring Chinook salmon were PIT tagged to monitor travel time and estimate survival to Lower Granite Dam after release. These fish were part of the Comparative Survival Study (see SPECIAL STUDIES section for details).

### SMOLTS RELEASES

Idaho FRO began monitoring stream flows in the Clearwater River and into Lower Granite Reservoir March 1, 2003 to coordinate spring Chinook salmon smolt releases with increases in the hydrograph. Mean daily flows into Lower Granite Reservoir remained below the 10 year average except from the 13 to the 16 of March, 2003. In contrast, flows in the Clearwater were much higher than the 10 year average for most of the monitoring period. By the 19<sup>th</sup> of March, flows in Snake River had receded somewhat so that inflow into Lower Granite Reservoir went below the 10 year average. However, rainstorm events in the Clearwater River basin significantly increased flows in the Clearwater River, exceeding the 10 year average (**Figures 2 and 3**). A systems operations request (#2003-03) was process through the Salmon Managers for increased flows out of Dworshak Reservoir to coincide with smolt releases at Dworshak NFH on the 19<sup>th</sup> and 20<sup>th</sup> of March. Releases were made into the North Fork Clearwater River the late afternoons on those dates. A total of 1,033,982 Chinook smolts were released at a size of 21 fish per pound, 137 mm total length.



**Figure 2.** Mean daily flow compared to the 10 year average in Lower Granite Reservoir during March 2003.



**Figure 3.** Mean daily stream discharge of the Clearwater River at the Orofino bridge, 2003.

## FISH HEALTH

### Adults

Holding - During the period of holding prior to spawning, formalin treatments were administered under veterinary prescription to adults to retard fungus infection. Formalin treatments were administered as bath treatments for one hour per day, 3 days per week at a concentration of 1:6,000.

Pre-Spawning - Beginning at 3 weeks prior to spawning, all adult females which returned before start of spawning were injected with the antibiotic Erythromycin under veterinary prescription to decrease levels of *Renibacterium salmoninarum* (Bacterial Kidney Disease) in the eggs. Each female injected received a dosage of 20 mg/kg of body weight.

Spawning - 13/208 (6.25%) adults tested positive for IHNV (Infectious Hematopoietic Necrosis Virus). Ovarian fluid samples were 3 pooled and spleens were 5 pooled. All spleen tissues were sampled from males.

Results positive for IHNV by take:

Take 1: 0/24 ovarians, 0/12 spleens

Take 3: 0/36 ovarians, 0/12 spleens

Take 4: 6/87 ovarians, 3/12 spleens

Take 5: 4/25 spleens



All female adults were tested for Bacterial Kidney Disease (*Renibacterium salmoninarum*) by ELISA (Enzyme-Linked Immunosorbent Assay)

Results:

Not Detected - 206  
Low - 84  
Medium - 33  
High- 26

SCS adults were also positive for the parasite *Ceratomyxa shasta* by examination of wet mounts from scrapes of the walls of the intestines.

### **Juveniles**

Production Monitoring – Beginning in November, 10 fish per month were sampled for BKD by ELISA.

Results:

11-22-02 – Not Detected: 10  
12-23-02 – Not Detected: 10  
1-17-03 – Not Detected: 9, Low: 1  
2-19-03 – Not Detected: 10

August -- Low levels *Epitheliocystis* on the skin and *Sanguinicola* in the gills. No treatment recommended at this time.

November – Low levels of the parasite *Ambiphyra* on the skin; fish appear healthy.

December – Low levels of parasites *Epitheliocystis* on the skin and *Sanguinicola* in the gills; healthy fish at this time.

January – Low levels of external parasites *Epistylis* and *Epitheliocystis* were detected on the skin.

February – Low levels of the external parasite *Epistylis* was detected on the skin. Low levels *Sanguinicola* were detected in the gills.

March – Low levels of the external parasite *Epistylis* were detected on the skin. Moribund fish sampled from tail end of pond. All had patches of fungus, especially on the tails. Some had exophthalmia. Gills were very pale and swollen. Internally, petechial hemorrhages were seen, primarily in the fat. Kidney and spleen imprints showed necrobiotic bodies indicative of IHNV. No bacteria were seen. Blood smears were negative for EIBS. Recommendations were to isolate pond and remove all sick or moribund fish.

Pre-release exam - 60 fish

ELISA Results: Not detected – 60

Low - 0  
Medium - 0  
High - 0

Viral assays - negative

Bacterial assays - negative

Hematocrits - 20 samples, all in normal range

At time of prerelease exam (3/11/03) 11 fish had parr marks, 35 had partial parr marks, and 14 had no parr marks.

## **Adult Returns**

### I-Ocean Adults (2004 Return)

113/213 (53.05%) adults tested positive for IHNV (Infectious Hematopoietic Necrosis Virus). Ovarian fluid samples were 3 pooled and spleens 5 pooled. All spleen tissues were sampled from males.

Results positive for IHNV by take:

Take 1: 12/36 ovarians, 0/9 male spleens

Take 2: 9/18 ovarians

Take 3: 71/95 ovarians, 5/24 male spleens

Take 5: 3/3 ovarians, 13/28 male spleens

All female adults were tested for Bacterial Kidney Disease (*Renibacterium salmoninarum*) by ELISA (Enzyme-Linked Immunosorbent Assay)

Results:

Not Detected - 404

Low - 22

Medium - 6

High- 7

SCS adults were also positive for the parasite *Ceratomyxa shasta* by examination of wet mounts from scrapes of the walls of the intestines.

### II-Ocean Adults (2005 Return)

92/210 (43.8%) adults tested positive for IHNV (Infectious Hematopoietic Necrosis Virus). Ovarian fluid samples were 3 pooled and spleens 5 pooled. All spleen tissues were sampled from males.

Results positive for IHNV by take:

Take 1: 39/62 ovarians

Take 2: 42/87 ovarians, 3/18 spleens

Take 3: 1/1 ovarians, 5/40 spleens

All female adults were tested for Bacterial Kidney Disease (*Renibacterium salmoninarum*) by ELISA (Enzyme-Linked Immunosorbent Assay)

Results:

Not Detected - 327

Low - 45

Medium - 2

High- 0

SCS adults were also positive for the parasite *Ceratomyxa shasta* by examination of wet mounts from scrapes of the walls of the intestines.

### III-Ocean Adults (2006 Return)

164/210 (78.1%) adults tested positive for IHNV (Infectious Hematopoietic Necrosis Virus). Ovarian fluid samples were 3 pooled and spleens 5 pooled. All spleen tissues were sampled from males.

Results positive for IHNV by take:

Take 1: 69/72 ovarians, 10/25 spleens

Take 2: 75/78 ovarians, 10/35 spleens

All female adults were tested for Bacterial Kidney Disease (*Renibacterium salmoninarum*) by ELISA (Enzyme-Linked Immunosorbent Assay)

Results:

Not Detected - 402

Low - 36

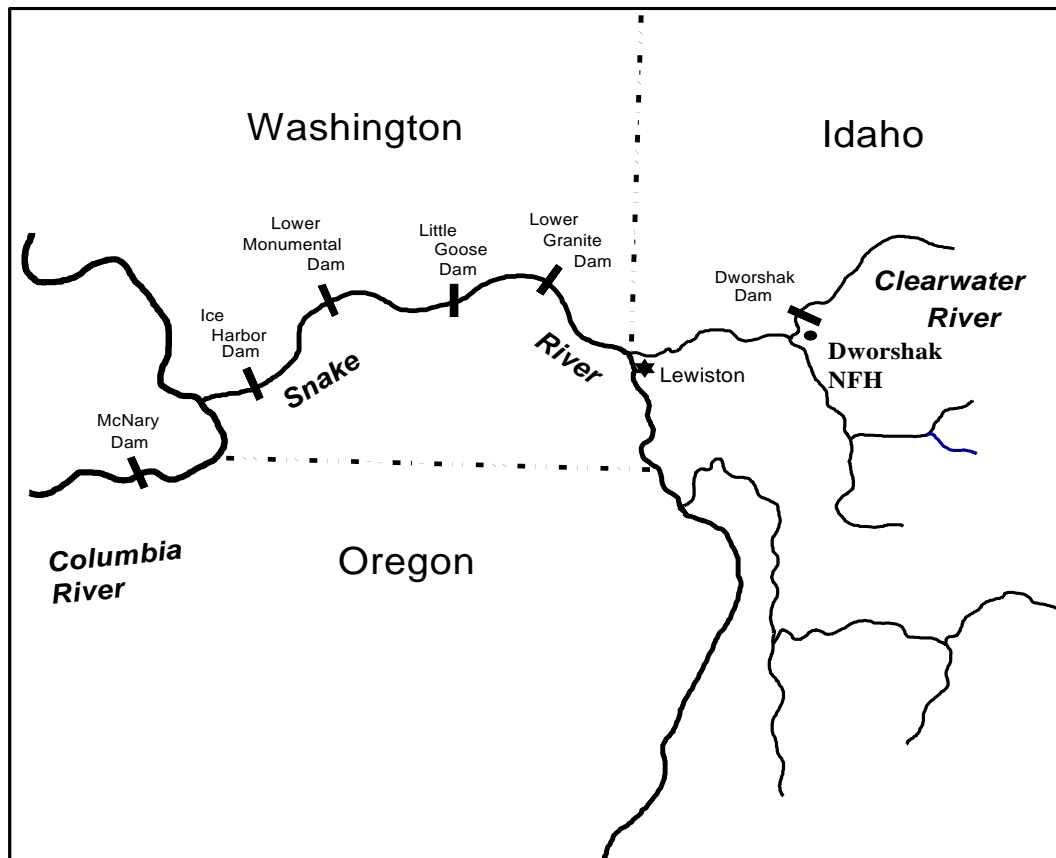
Medium - 2

High- 1

SCS adults were also positive for the parasite *Ceratomyxa shasta* by examination of wet mounts from scrapes of the walls of the intestines.

### **SMOLT EMIGRATION**

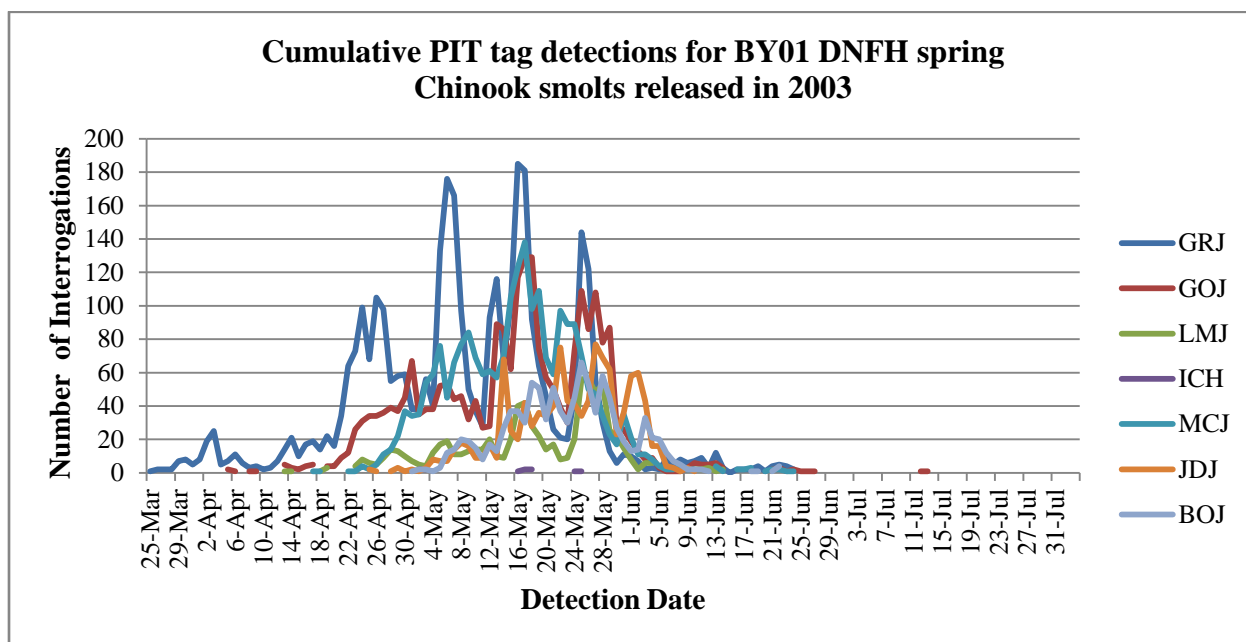
The performance of spring Chinook salmon smolts is monitored and evaluated using PIT tags after they are released from the hatchery. The tags are interrogated at Lower Granite, Little Goose, and Lower Monumental dams on the Lower Snake River and at McNary, John Day and Bonneville dams on the lower Columbia River (**Figure 4**). PIT tags provide information on travel time and survival during emigration. A total of 54,705 PIT-tagged spring Chinook salmon smolts were released in 2003 as part of the Comparative Survival Study, (CSS). The CSS is a multi-year program that estimates survival rates over different life stages for spring and summer Chinook and steelhead produced in major hatcheries. (See **SPECIAL STUDIES** section for details)



**Figure 4.** Dams on the lower Snake and Columbia rivers. Lower Granite, Little Goose, Lower Monumental, and McNary dams are PIT-tag interrogation facilities for monitoring smolts emigration. Bonneville and John Day dams are not shown.

#### Travel Time

Travel time for BY01 spring Chinook smolts released from Dworshak NFH through the FCRPS is monitored using PIT tag interrogations at the juvenile bypass facilities (**Figure 5**).

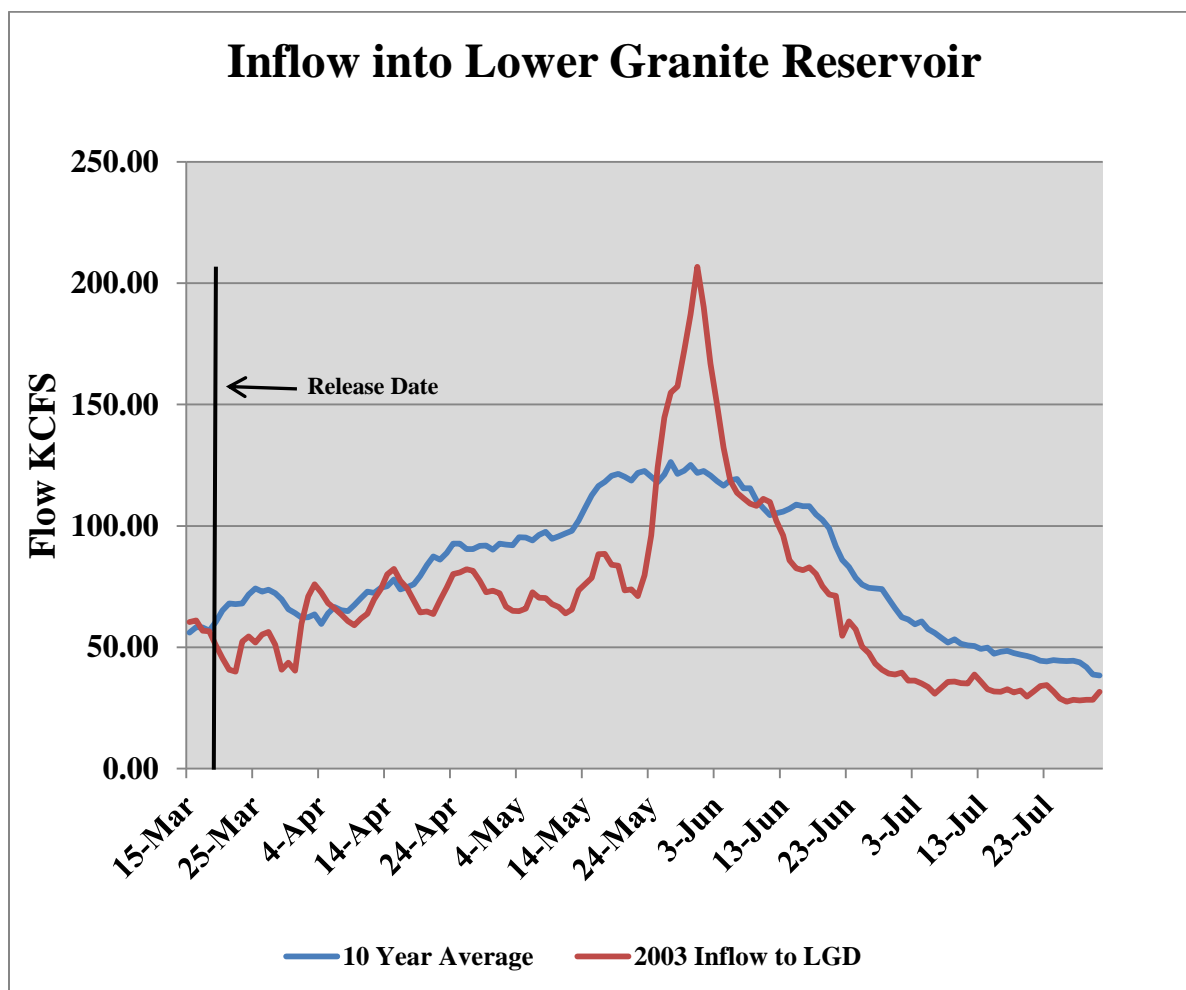


**Figure 5.** Cumulative PIT tag detections for BY2001 DNFH spring Chinook smolts at juvenile bypass facilities in the Lower Snake and Columbia rivers.

The migration time of BY2001 smolts released from Dworshak NFH to Lower Granite Dam ranged from 6.0 days to 121.4 days with a harmonic mean travel time of 43.6 (SE=0.23) days. Ten percent arrived at Lower Granite Dam within 33.5 days; 50% and 90% arrived within 49.5 days and 67.3 days, respectively. Smolts that migrated through the hydro system arrived at Bonneville Dam on average 62.7 (SE=0.17) days after release.

## River Flows

Flows in the Lower Snake River were somewhat lower, but tracked the 10-year average during most of the period of smolts emigration from April through July (**Figure 6**). Inflow into Lower Granite Reservoir only exceeded 100,000 cubic feet per second (cfs) from May 25 through June 11, a narrower time period than the 10-year average. However, flows spiked sharply during that period significantly exceeding the 10-year average.



**Figure 6.** Mean daily inflow to Lower Granite Reservoir from March 15 through July 31, 2003 during spring Chinook salmon emigration after release from Dworshak NFH. The vertical line indicates the date smolts were released. The 10 year average is shown for perspective.

Estimated Smolt Survival

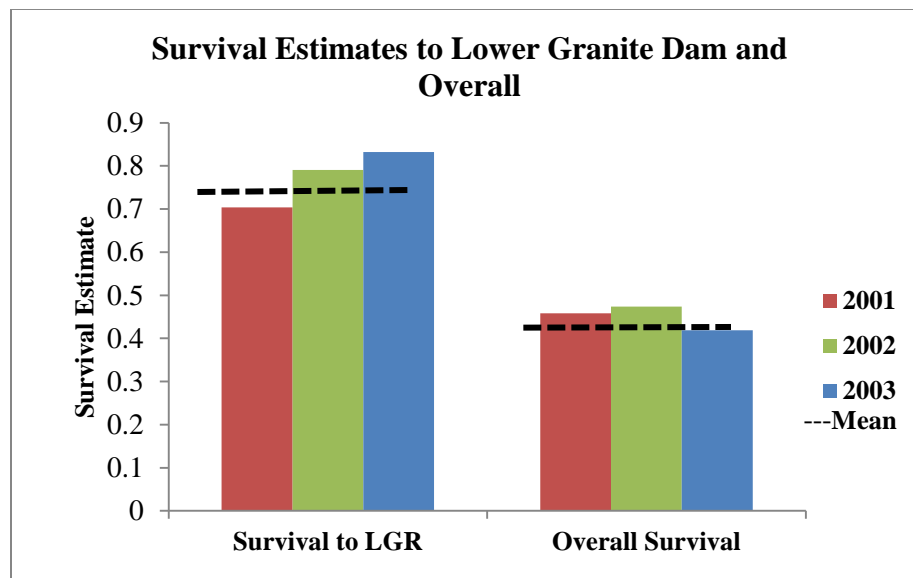
Survival probabilities through the Federal Columbia River Power System (FCRPS) were calculated using SURvival under Proportional Hazards 2.1 (SURPH) (Lady et al. 2001) (**Table 11**).

**Table 11.** Cumulative survival estimates of BY2001 spring Chinook smolts released from Dworshak NFH as they pass juvenile bypass facilities in the Lower Snake and Columbia rivers.

River Reach	Survival Estimate	Standard Error
Release (NF Clearwater) – Lower Granite Dam	0.704	0.0076
Lower Granite Dam – Little Goose Dam	0.910	0.0165
Little Goose Dam – Lower Monumental Dam	0.897	0.0251
Lower Monumental Dam – McNary Dam	0.983	0.0282
McNary Dam – John Day Dam	0.922	0.0327
John Day Dam – Bonneville Dam	0.879	0.0901
Overall	0.458	0.0446

River reach survival for spring Chinook smolts ranged from 0.704 (SE= 0.0076) to 0.983 (SE=

0.0282) with the lowest survival occurred between release at Dworshak NFH and Lower Granite Dam; highest survival occurred between Lower Monumental and McNary dams. Overall survival to Bonneville Dam was 0.458 (SE=0.0446); lower than BY02 and BY03 (**Figure 7**).



**Figure 7.** Mean survival estimates to Lower Granite Dam and overall survival estimate through the Federal Columbia River Power System, BY2001-BY2003.

## ADULT RETURNS

Estimating the numbers of Dworshak NFH origin adult spring Chinook salmon that return from the ocean for a single brood year is quite complicated and challenging for several reasons. First, the adult returns entering the mouth of the Columbia River from the ocean are composed of mixed stocks from various state, Tribal, and federal fishery programs and are harvested in the ocean, the Columbia, Snake, and Clearwater rivers. The adults that enter the Clearwater River each year originate from smolt release programs at Dworshak NFH, Kooskia NFH, Idaho Department of Fish and Game (IDFG) facilities at Powell, Red River, and Crooked River, and Nez Perce Tribal Hatchery program releases in Lolo Creek, Newsome Creek, and the Selway River. The challenge is further complicated because the adults return over three successive years at different ages after spending one to three years in the ocean (Jones *et al.* 2011a). Thus, Brood Year 2001 adults, released as smolts in 2003, return as I-Ocean adults in 2004, II-Ocean adults in 2005, and III-Ocean adults in 2006.

Except for the actual rack return to Dworshak NFH, estimates of the numbers of adults that are harvested (commercial, sport, and Tribal) or are collected in other fishery programs, are based on coded-wire tag information. Coded-wire tags are used to help identify Dworshak NFH adult salmon in the mixed stock fisheries of the Columbia, Snake, and Clearwater rivers. Tags are recovered by various federal, state, and Tribal agencies from commercial and sport harvest samples and are reported to Pacific States Marine Fisheries Commission (PSMFC) which maintains the information in the Regional Mark Information System (RMIS). Generally, agencies expand the number of coded-wire tags collected by the sampling rate to provide an estimate of the total number of tags that would have been collected if the sampling rate would

have been 100%. The total number of adults harvested or collected is then estimated by dividing the total number of tags collected by the hatchery tagging rate (Jones *et al.* 2011b). Estimates for various fisheries are provided below.

### **Ocean and Lower Columbia River Below Bonneville Dam**

Very few adults are harvested in the ocean and the lower Columbia River below Bonneville Dam, although in years when returns are high, some are reported from various Oregon and Washington sport and commercial fisheries. From 2004 to 2007, an estimated 423 Dworshak NFH BY2001 adults were harvested; 323 in sport fisheries and 100 in non-tribal commercial net fisheries.

### **Columbia River from Bonneville Dam to McNary Dam**

The Columbia River from Bonneville Dam to McNary Dam is the section designated for Tribal Treaty commercial, ceremonial, and subsistence harvest, although Oregon and Washington sports harvest occurs there also. From 2004 to 2007, an estimated 454 Dworshak NFH BY2001 adults were reported harvested in Tribal fisheries.

### **Strays Below and Above McNary Dam**

For purposes of adult return accounting, strays are defined as fish that are collected or harvested in any fishery or are captured at any hatchery rack or tributary weir outside the normal adult migration corridor. Over the years, Dworshak NFH adults have strayed out of the normal migration corridor and have been collected at various hatcheries, fish weirs, fish ladders, or harvested in tributary sport and Tribal fisheries. From 2004 to 2007, 32 BY2001 Dworshak NFH adult strays were collected in the Columbia River above McNary Dam. There were no strays reported below McNary Dam and only 16 in the Snake River basin.

### **Lower Snake River from Mouth to Lower Granite Dam**

Very few Dworshak NFH adults are reportedly harvested from the mouth of the Snake River up to Lower Granite Dam and those that are have been caught in sport fisheries reported by Washington. There were no BY2001 adults reported harvested or otherwise collected in this section from 2004 to 2007.

### **Lower Snake and Clearwater River above Lower Granite Dam**

It is challenging to account for the all the Dworshak NFH origin adults that return to the project area above Lower Granite Dam because of the mixed stock fishery, accounting for adults among the various harvest programs, and accounting for the contribution of the various age classes returning over three years. For BY2001, an estimate was made based on the Dworshak NFH rack returns, the Nez Perce Tribal subsistence harvests, and the sports harvests that occurred in 2004, 2005, and 2006. Because of data limitations, escapement could not be estimated, so our total adult return estimate is biased low. Assessment of the rack return, and the sport and Tribal harvests are provided below.

#### **Rack Return to Dworshak NFH**

A total of 1,033,982 Brood Year 2001 spring Chinook salmon smolts were released in 2003 and



returned as adults in 2004 (I-Ocean), 2005 (II-Ocean), and 2006 (III-Ocean). The total adult return to the hatchery rack was 984 fish (**Table 12**).

### *Tribal Fisheries*

The Nez Perce Tribal Department of Fisheries Resource Management is responsible for reporting harvest data in the Tribal fishery. Harvest occurs primarily in the North Fork of the Clearwater River near the ladder at Dworshak NFH. Data on the age composition of the harvest is generally not available. For that reason, in years when it is not available from harvest sampling, it is assumed that the age composition of the harvest is similar to the age composition of the rack return to Dworshak NFH. The total estimated Tribal harvest was 148 and is reported by estimated age class each year in **Table 12**.

### *Idaho Sport Fisheries*

The Idaho Department of Fish and Game (IDFG) is responsible for collecting and reporting information on sport harvest. Estimates of the numbers of adults and jacks harvested in the sport fishery are based on expanded numbers of coded-wire tags collected during sport fish harvest surveys by the IDFG. These tags are expanded by tagging and sample rates, across multiple creel survey river sections (J. Cassinelli, IDFG personal communication).

Sport harvest of BY2001 spring Chinook salmon occurred in 2004 (I-Ocean fish), in 2005 (II-Ocean fish) and in 2006 (III-Ocean fish). IDFG reported a total estimated harvest of 56 I-Ocean fish in 2004, 494 II-Ocean fish in 2005, and 0 III-Ocean fish in 2006 for a total of 550 BY2001 Dworshak NFH origin adult salmon harvested by the sport fishery (**Table 12**).

### *Escapement and Strays*

Currently, escapement is estimated through a process of elimination. The Idaho FRO and IDFG have recently cooperated in developing a method to use adult PIT tag returns at Lower Granite Dam to estimate the total adult return of Dworshak NFH spring Chinook salmon to Lower Granite Dam using expansion factors (Peery *et al.* 2011). Escapement is estimated by subtracting the rack return and the total harvest from the estimated adult return to Lower Granite Dam. However, adequate PIT-tag data was not available to calculate escapement for any of the adult return years for BY2001 and there were no strays reported above Lower Granite Dam in the RMIS coded-wire tag database.

### *Estimated Minimum Total Adult Return Above Lower Granite Dam*

Based on the rack return and the estimated sport and Tribal harvests, the minimum estimated adult return to Lower Granite Dam for BY2001 is 1,682 (**Table 12**). Since we were not able to calculate an escapement, our estimate is biased low.

### *Estimated Minimum Total Adult Return to the Columbia River*

The total number of BY2001 spring Chinook salmon adults estimated to have returned to the Columbia River is 2,591; 909 below LGD and 1,682 above LGD.

**Table 12.** Summary of adult returns to Dworshak NFH for Brood Year 2001 spring Chinook salmon (Idaho Fishery Resource Office 2011). A total of 1,033,982 smolts were released from Dworshak NFH in 2003. This table does not include strays into the upper Snake River and that do not enter the Clearwater River.

Return Year	Ocean Age	Rack Return <sup>1</sup>	Sport Harvest <sup>2</sup>	Tribal Harvest <sup>3</sup>	Escapement	Total
2004	I	142	56	25	NA	<b>223</b>
2005	II	686	494	80	NA	<b>1,260</b>
2006	III	156	0	43	NA	<b>199</b>
<b>Total</b>		<b>984</b>	<b>550</b>	<b>148</b>	<b>NA</b>	<b>1,682</b>

<sup>1</sup> Idaho Fishery Resource Office 2011, Appendix Table 3.

<sup>2</sup> Idaho Fishery Resource Office 2011, Appendix Table 7.

<sup>3</sup> Idaho Fishery Resource Office 2011, Appendix Table 8.

## SPECIAL STUDIES

### Comparative Survival Study

The Dworshak Fishery Complex has been cooperating with the Fish Passage Center in a Comparative Survival Rate Study of hatchery PIT-tagged spring Chinook salmon since 1997. The Comparative Survival Study evaluates the effectiveness of transporting smolts past the Snake and Columbia River dams as opposed to migration through the hydro system. Dworshak NFH released 54,705 PIT-tagged BY2001 spring Chinook salmon smolts in 2003. Results of the Comparative Survival Study can be found at [www.fpc.org](http://www.fpc.org).

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